Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of the claims in the application.

Listing of Claims:

Claim 1 (currently amended): A process for conducting a chemical reaction which has a gas phase reactant and a gas phase product, while performing separations by pressure swing adsorption of the product component from the reactant component over an adsorbent material on which one of the reactant and the product components is a more readily adsorbed component and the other is a less readily adsorbed component under increase of pressure, the process including the steps of:

(a) introducing a feed gas containing the reactant component to a reaction space,

(b) conducting the reaction within the reaction space so as to obtain a gas mixture containing the reactant and the product components

(c) contacting the gas mixture containing the reactant and the product components with the adsorbent material in flow paths extending between first and second valve faces in a rotor,

(d) supplying gas to the first or second valve face ~~at incrementally increasing pressures~~ to achieve an upper pressure of the process,

(e) withdrawing gas from the first or second valve face ~~at incrementally decreasing pressures~~ to achieve a lower pressure of the process, and

(f) rotating the rotor at a rotational speed so as to establish cyclic fluid communication for each of the flow paths through the first and the second valve faces in a cyclic sequence, so as to establish flow in each flow path directed from

the first valve face to the second valve face at substantially the upper pressure, and to establish flow in each flow path directed from the second valve face to the first valve face at substantially the lower pressure.

Claim 2 (original): The process of claim 1, in which the reactant component is the less readily adsorbed component, and withdrawing a product enriched in the more readily adsorbed component from adjacent the first valve face.

Claim 3 (original): The process of claim 2, further withdrawing gas enriched in the more readily adsorbed component from the first valve face, compressing that gas to an increased pressure, and refluxing the gas to the first valve face and thence the flow paths at the increased pressure, so as to increase the concentration of the more readily adsorbed component adjacent the first valve face.

Claim 4 (original): The process of claim 2, in which the reaction is exothermic.

Claim 5 (original): The process of claim 4, in which a first reactant component is hydrogen, a second reactant component is nitrogen, and the produce component is ammonia.

Claim 6 (original): The process of claim 4, in which a first reactant is hydrogen, a second reactant component is carbon monoxide, and the product component is methanol.

Claim 7 (original): The process of claim 4, in which a first reactant component is hydrogen, a second reactant component is carbon monoxide, and the product component is hydrocarbon which is a liquid at ambient temperature.

Claim 8 (original): The process of claim 4, in which a first reactant component is methane, a second reactant component is oxygen, and the product component is a higher hydrocarbon.

Claim 9 (original): The process of claim 8, in which a first reactant component in methane, a second reactant component is oxygen, and the product component is ethylene.

Claim 10 (original): The process of claim 1, in which the reactant component is the more readily adsorbed component, and withdrawing a product enriched in the less readily adsorbed component from adjacent the second valve face.

Claim 11 (original): The process of claim 10, further withdrawing gas enriched in the less readily adsorbed component from the second valve face, expanding that gas to a reduced pressure not less than the lower pressure, and refluxing that gas to the second valve face and thence the flow paths at the reduced pressure, so as to increase the concentration of the less readily adsorbed component adjacent the second valve face.

Claim 12 (original): The process of claim 2, in which the reaction is endothermic.

Claim 13 (original): The process of claim 8, in which the reactant component is ammonia, a first product component is hydrogen, and a second component is nitrogen.

Claim 14 (original): The process of claim 8, in which a first reactant component is methanol, a first product component is hydrogen, and a second component is carbon monoxide.

Claim 15 (original): The process of claim 8, in which a first reactant component is methanol, a second reactant component is water vapour, a first product component is hydrogen, and a second component is carbon dioxide.

Claim 16 (original): The process of claim 1, further maintaining the temperature of the flow path adjacent the first valve face approximately at a first temperature, and maintaining the temperature of the flow path adjacent the second valve face approximately at a second temperature.

Claim 17 (original): The process of claim 1, maintaining the first temperature to be greater than the second temperature, and exchanging heat between the gas mixture in the flow paths and solid material with heat capacity disposed along the flow paths.

Claim 18 (original): The process of claim 1, maintaining the second temperature to be greater than the first temperature, and exchanging heat between the gas mixture in the flow paths and solid material with heat capacity disposed along the flow paths.

Claim 19 (original): The process of claim 1, further conducting the reaction within the flow paths, a portion of each of which being a reaction space.

Claim 20 (original): The process of claim 1, further comprising the step of conducting heat between extended heat transfer surfaces in the rotor and the flow paths intermediately between the first and second valve faces.

Claim 21 (original): The process of claim 12, further comprising the step of conducting heat to the flow paths from a heat transfer fluid externally contacting heat exchange surfaces in the rotor.

Claim 22 (original): The process of claim 12, further comprising the step of admitting air or oxygen providing heat in the flow paths by catalytic combustion of a reactant component within the flow paths from a heat transfer fluid externally contacting heat exchange surfaces in the rotor.

Claim 23 (original): The process of claim 12, wherein the reactant component comprises a first component which is a hydrocarbon, such as methane, and a second component, comprising steam, and wherein the product component comprises a strongly adsorbed component, which is carbon dioxide, and a component, which is hydrogen, and wherein the adsorbent material is selective for carbon dioxide in the presence of steam at elevated temperature.

Claim 24 (original): The process of claim 23 further comprising the step of providing a nickel catalyst in the flow paths.

Claim 25 (original): The process of claim 23 further comprising the step of providing a platinum group catalyst in the flow paths.

Claim 26 (original): The process of claim 23 in which the first and second reactant components are introduced to the first valve face at substantially the upper pressure while hydrogen is delivered from the second valve face, and carbon dioxide is delivered from the first valve face at substantially the lower pressure.

Claim 27 (original): The process of claim 24 in which steam is admitted to the second valve face at substantially the lower pressure so as to assist purge.

Claim 28 (original): The process of claim 23 in which air or oxygen is admitted to the second valve face at substantially the lower pressure so as to assist purge while providing heat to the flow paths for the endothermic reaction.

Claim 29 (original): Apparatus for conducting a chemical reaction which has a gas phase reactant component and a gas phase product component, one of the reactant and the product components being a more readily adsorbed component and the other being a less readily adsorbed component under pressure increase over an adsorbent material, the apparatus comprising:

(a) a rotary module for pressure swing adsorption separation of a gas mixture containing the reactant and product components, the rotary module comprising a stator and a rotor with an axis of rotation, the stator and rotor being mutually engaged in fluid communication across a first rotary valve surface and a second rotary valve surface both centred on the axis of rotation; the stator having a plurality of first function compartments each opening into the first rotary valve surface in an angular sector thereof, and a plurality of second function

compartments each opening into the second rotary valve surface in an angular sector thereof; the rotor having a plurality of angularly spaced adsorber elements wherein the adsorbent material contacts flow paths extending in a flow direction between a first end communicating by a first aperture to the first valve surface and a second end communicating by a second aperture to the second valve surface, and with means to rotate the rotor such that each of the first apertures is opened in fluid communication to the first function compartments by rotation of the rotor bringing apertures sequentially into the angular sector of each first function compartment, while each of the second apertures is opened in fluid communication to the second function compartments by rotation of the rotor bringing the apertures sequentially into the angular section of each second function compartment so as to achieve cycling of the pressure in each adsorber element between an upper pressure and a lower pressure,

(b) compression and expansion means cooperating with a feed function compartment to generate flow in each flow path directed from the first end to the second end of the flow path at substantially the upper pressure, and cooperating with an exhaust function compartment to generate flow in each flow path directed from the second end to the first end of the flow path at substantially the lower pressure,

(c) a reaction space in which the reaction is conducted, the reaction space communicating with the flow paths, and

(d) means to provide the reactant component to the apparatus, and to deliver the product component from the apparatus.

Claim 30 (original): The apparatus of claim 29, in which the reaction space is external to the rotary module and communicates to a function compartment thereof, and fluid communication between the reaction space and each flow path is established as an aperture of that flow path is opened sequentially to the said function compartment.

Claim 31 (original): The apparatus of claim 29, in which the reaction space is within a flow path of the rotary module, and each such flow path has a similar reaction space therein.

Claim 32 (original): The apparatus of claim 29, with means to stimulate the chemical reaction to proceed in the reaction space.

Claim 33 (original): The apparatus of claim 32, in which the means to stimulate the chemical reaction is a heterogeneous catalyst.

Claim 34 (original): The apparatus of claim 29, in which the reaction is exothermic, and the reactant component is a less readily adsorbed component while the product component is a more readily adsorbed component.

Claim 35 (original): The apparatus of claim 34, with compressor means for withdrawing gas enriched in the more readily adsorbed component from the first valve face, compressing that gas to an increased pressure, and refluxing that gas to the first valve face and thence the flow paths at the increased pressure, so as to increase the concentration of the more readily adsorbed component adjacent the first valve face.

Claim 36 (original): The apparatus of claim 29, in which the reaction is endothermic, and the reactant component is a more readily adsorbed component while the product component is a less readily adsorbed component.

Claim 37 (original): The apparatus of claim 36, with pressure let-down means for withdrawing gas enriched in the less readily adsorbed component from the second valve face, expanding that gas to a reduced pressure not less than the lower pressure, and refluxing that gas to the second valve face and thence the flow paths at the reduced pressure, so as to increase the concentration of the more readily adsorbed component adjacent the second valve face.

Claim 38 (currently amended): Rotary module for conducting a chemical reaction which has a gas phase reactant component and a gas phase product component and for separating the

product component ~~form~~ from the reactant component by pressure swing adsorption, one of the reactant and the product components being a more readily adsorbed component and the other being a less readily adsorbed component under pressure increase over an adsorbent material, the rotary module comprising a stator and a rotor with an axis of rotation, the stator and rotor being mutually engaged in fluid communication across a first rotary valve surface and a second rotary valve surface both centred on the axis of rotation; the stator having a plurality of first function compartments each opening into the first rotary valve surface in an angular sector thereof, and a plurality of second function compartments each opening into the second rotary valve surface in an angular sector thereof; the rotor having a plurality of angularly spaced flow paths each extending in a flow direction between a first end communicating by a first aperture to the first valve surface and a second end communicating by a second aperture to the second valve surface with the adsorbent material contacting a flow channel within each flow path and with a reaction space for conducting the chemical reaction within each flow path; with means to rotate the rotor such that each of the first apertures is opened in fluid communication to the first function compartments by rotation of the rotor bringing the apertures sequentially into the angular sector of each first function compartment, while each of the second apertures is opened in fluid communication to the second function compartments by rotation of the rotor bringing the apertures sequentially into the angular sector of each second function compartment so as to achieve cycling of the pressure in each adsorber element between an upper pressure and a lower pressure established by compression and expansion means cooperating with the function compartments.

Claim 39 (original): The rotary module of claim 38, wherein the function compartments also include a plurality of pressurization compartments for subjecting the flow paths to a plurality of incremental pressure increases between the upper and lower pressures.

Claim 40 (original): The rotary module of claim 39, wherein the pressurization compartments include feed pressurization compartments opening into the first rotary valve surface for delivering the gas mixture to the flow paths at incrementally different pressures intermediate between the upper and lower pressures.

Claim 41 (original): The rotary module of claim 39, wherein the pressurization compartments include light reflux return compartments opening into the second rotary valve surface for delivering gas enriched in a less readily adsorbed component to the flow paths at a plurality of incrementally different pressures.

Claim 42 (original): The rotary module of claim 38, wherein the function compartments also include a plurality of blowdown compartments for subjecting the flow paths to a plurality of incremental pressure decreases between the upper and lower pressures.

Claim 43 (original): The rotary module of claim 42, wherein the blowdown compartments include light reflux exit compartments opening into the second stator valve surface for removing gas enriched in a less readily adsorbed component as cocurrent blowdown from the flow paths at a plurality of incrementally different pressures.

Claim 44 (original): The rotary module of claim 42, wherein the blowdown compartments include countercurrent blowdown compartments opening into the first stator valve surface for removing gas enriched in a more readily adsorbed component from the flow paths at a plurality of incrementally different pressures.

Claim 45 (original): The rotary module of claim 38, wherein the function compartments are disposed around the respective valve surfaces for conveying gas to and from the flow paths in a common predetermined sequence for each flow path, the sequence comprising the steps of (1) supplying the gas mixture at the upper pressure from a first function compartment as a feed compartment to the flow path first end while removing gas enriched in a less readily adsorbed component as a light product gas at substantially the upper pressure from the flow path second end to a second function compartment as a light product compartment, (2) releasing gas enriched in a less readily adsorbed component from the second end as light reflux gas so as to reduce the pressure in the flow path to an intermediate pressure level, (3) releasing gas enriched in a more readily adsorbed component from the first end as a countercurrent blowdown gas so as to reduce the pressure in the flow path from an intermediate pressure level, (4) removing gas enriched in a more readily adsorbed component as a heavy product gas at the lower pressure from the first end

to a first function compartment as a heavy product compartment, and (5) supplying light reflux gas at a pressure intermediate the upper and lower pressure to a light reflux return compartment and thence to the second end.

Claim 46 (original): The rotary module of claim 38, with the sequence also including after step (5) a step (6) supplying the gas mixture at an intermediate pressure less than the upper pressure to a feed pressurization compartment and thence to the first end.

Claim 47 (original): The rotary module of claim 38, wherein each function compartment is shaped to provide uniform gas flow through the corresponding sector of the first or second rotary valve face.

Claim 48 (original): The rotary module of claim 38, wherein each of the function compartments simultaneously communicates with apertures to at least two angularly spaced adsorber elements so as to provide substantially uniform gas flow at substantially steady pressure through each of the function compartments.

Claim 49 (original): The rotary module of claim 38, wherein dead volume associated with the first and second apertures is substantially zero.

Claim 50 (original): The rotary module of claim 38, wherein flow channels in a flow path are provided as a plurality of substantially identical parallel passages through the adsorbent material.

Claim 51 (original): The rotary module of claim 50, wherein the adsorbent material is supported in thin sheets, the sheets being laminated with spacers therebetween, and the flow channels are established by the spacers between adjacent pairs of the sheets.

Claim 52 (original): The rotary module of claim 51, further comprising fluid sealing means cooperating with the stator to limit fluid leakage between function compartments in each

of the first and second rotary valve sealing faces, and to substantially prevent fluid leakage from or into each of the first and second rotary valve faces.

Claim 53 (original): The rotary module of claim 52, wherein the rotor has a first rotor face for engaging the fluid sealing means in the first rotary valve surface and a second rotor face for engaging the fluid sealing means in the second rotary valve surface, the first rotor face being penetrated by the first apertures and the second rotor face being penetrated by the second apertures, for cyclically exposing each adsorber element to a plurality of discrete pressure levels between the upper and lower pressures.

Claim 54 (original): The rotary module of claim 38, wherein an adsorber element in each flow path is formed from a plurality of adsorber sheets, each said sheet including a reinforcement material, an adsorbent material deposited therein, a binder for securing the adsorbent material, and a spacer provided between each adjacent pair of adsorbent sheets for providing the flow channel therebetween.

Claim 55 (original): The rotary module of claim 54, wherein the reinforcement material is selected from a mineral or glass fiber matrix such as a woven or non-woven glass fiber scrim, a metal wire matrix such as a wire mesh screen, or a metal foil such as an anodized aluminum foil.

Claim 56 (original): The rotary module of claim 38, wherein the adsorbent material comprises a zeolite.

Claim 57 (original): The rotary module of claim 54, wherein the reaction space is a zone of the adsorber element with a heterogeneous catalyst contacting the flow channels therein.

Claim 58 (original): The rotary module of claim 54, wherein the reaction space is a zone of the adsorber element with a heterogeneous catalyst contacting the flow channels therein.

Claim 59 (currently amended): The rotary module of claim 58, in which the adsorbent material in at least one of the zones is active as a heterogeneous catalyst.

Claim 60 (original): The rotary module of claim 54, wherein the adsorber elements include a pair of opposite ends, and each said aperture is disposed immediately adjacent to a respective one of the opposite ends.

Claim 61 (original): The rotary module of claim 38, with the rotor having an annular volume containing the adsorber elements, with the flow direction being axial with respect to the axis of rotation, and with the first rotor face being a circular annular end surface of the rotor and the second rotor face being a circular annular end surface of the rotor, the first and second rotor faces being substantially normal to the axis of the rotation.

Claim 62 (original): The rotary module of claim 38, with the rotor having an annular volume containing the adsorber elements, with the flow direction being substantially radial with respect to the axis of rotation, and with the first rotor face being an external cylindrical surface of the rotor and the second rotor face being an internal cylindrical surface of the rotor.

Claim 63 (original): The rotary module of claim 51, further comprising a catalyst supported on the sheets.

Claim 64 (original): The rotary module of claim 55, in which the adsorber element is contained in a jacket with heat transfer surfaces to contact an external heat transfer fluid.

Claim 65 (original): The rotary module of claim 64, in which the reinforcement material is metallic and is in thermal conduction contact to the jacket.

Claim 66 (original): The rotary module of claim 65, in which the reinforcement material is a metal foil and wherein the spacer between each adjacent pair of adsorbent sheets is a metal foil with the flow channels etched therein according to a photolithographic pattern, and the jacket

is in part formed by diffusion bonding of the adjacent edges of the adsorbent sheet foils and the interleaved spacer foils to achieve fluid sealing integrity.